What is claimed is:

1. A high temperature fuel cell system comprising an anode channel, an anode inlet and an anode outlet, a first anode channel portion proximal to the anode inlet, a second anode channel portion proximal to the anode outlet, and a gas separation means operable to enrich a first gas component of an anode exhaust gas exiting the anode outlet to produce a first product gas enriched in the said first gas component, wherein;

the first anode channel portion comprises an anode material that is resistant to carbon deposition and active for direct oxidation of hydrogen, at least one hydrocarbon fuel or mixtures thereof; and

the second anode channel portion comprises an anode material that is catalytically active for steam reforming of at least one hydrocarbon.

2. The high temperature fuel cell system according to claim 1 wherein the system is configured such that at least a portion of the first product gas enriched in the first gas component can be provided as a portion of a fuel mixture supplied to the anode inlet.

3. The high temperature fuel cell system according to claim 2 wherein the first gas component comprises hydrogen.

4. The high temperature fuel cell system according to claim 2 wherein the high temperature fuel cell comprises a solid oxide fuel cell.

5. The high temperature fuel cell system according to claim 3 wherein the fuel mixture comprises steam and hydrogen in proportions of no more than 1.5 moles of steam per mole of hydrogen.

6. The high temperature fuel cell system according to claim 3 wherein the fuel mixture comprises steam, hydrogen and at least one hydrocarbon fuel wherein the molar ratio of steam to hydrocarbon fuel in the mixture is no greater than 1.5 to 1.

7. The high temperature fuel cell system according to claim 1 wherein the gas separation means comprises a rotary adsorption module containing an adsorbent material, and wherein the adsorbent material is capable of being periodically regenerated by means of pressure swing, temperature swing, displacement purge, or a combination thereof.

8. A high temperature fuel cell system comprising an anode channel having an anode inlet and an anode outlet, a cathode channel having a cathode inlet and a cathode outlet, a gas separation means operable to produce from air a first product gas enriched in oxygen, and a catalytic partial oxidation means wherein

said gas separation means is fluidly connected to the cathode inlet such that the gas separation means is capable of supplying at least a portion of the first oxygen-enriched product gas to the cathode inlet;

said catalytic partial oxidation means is fluidly connected to the cathode outlet such that the catalytic partial oxidation means is capable of receiving at least a portion of an exhaust gas from the cathode outlet for reaction with a hydrocarbon fuel mixture to produce a second product gas comprising syngas; and

the system is configured such that at least a portion of said second product gas can be provided as a portion of a fuel gas mixture which is supplied to the anode inlet.

9. The high temperature fuel cell system of claim 8, further comprising a second gas separation means operable to enrich a first gas component of an anode exhaust gas exiting the anode outlet to produce a third product gas enriched in the said first gas

component and wherein at least a portion of the third product gas enriched in the first gas component can be provided as a portion of the fuel gas mixture which is supplied to the anode inlet.

10. The high temperature fuel cell system of claim 8 wherein the anode and cathode channels are arranged such that the fuel gas mixture in the anode channel is capable of flowing in a direction countercurrent to a flow of the oxygen-enriched gas in the cathode channel.

11. The high temperature fuel cell system of claim 8 wherein the high temperature fuel cell comprises a solid oxide fuel cell.